Automatic microkeratome

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Abstract of **EP0873735**

An apparatus for transverse planar cutting of a cornea to expose a corneal surface to allow correction of myopia, the apparatus including a corneal suction ring (10) including a cornea engaging surface (12) on a side thereof and microkeratome dove tail guide surfaces on an opposite side, the dove tail guide surfaces being spaced apart, parallel and extend along opposite sides of an aperture arranged for exposing a portion of a cornea, a steering rod (26) releasably secured to an outer wall of the suction ring, a microkeratome (32) including a blade driven by a motor to execute a transverse planar cutting of corneal surface exposed by the corneal suction ring, the microkeratome having a dove tail for engaging and guidance by the dove tail tracks on the corneal suction ring, and a stepping motor connected to the steering rod and the microkeratome for controlling relative movement between the corneal suction ring and the microkeratome.

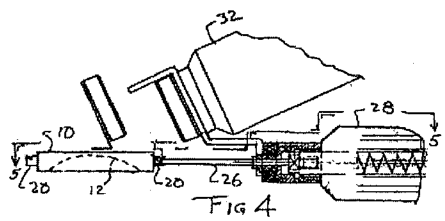

FIG 4

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(54) Automatic microkeratome

(57) An apparatus for transverse planar cutting of a cornea to expose a corneal surface to allow correction of myopia, the apparatus including a corneal suction ring (10) including a cornea engaging surface (12) on a side thereof and microkeratome dove tail guide surfaces on an opposite side, the dove tail guide surfaces being spaced apart, parallel and extend along opposite sides of an aperture arranged for exposing a portion of a cornea, a steering rod (26) releasably secured to an outer wall of the suction ring, a microkeratome (32) including a blade driven by a motor to execute a transverse planar cutting of corneal surface exposed by the corneal suction ring, the microkeratome having a dove tail for engaging and guidance by the dove tail tracks on the corneal suction ring, and a stepping motor connected to the steering rod and the microkeratome for controlling relative movement between the corneal suction ring and the microkeratome.

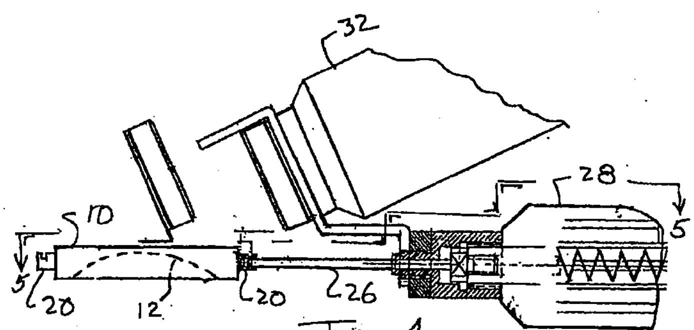

FIG 4

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Description

This invention relates to an apparatus for effecting a planar cutting of the cornea to form a lamella cutting attached by a hinge of corneal tissue to allow treatment by a laser for correction of myopia.

There has been established since about the beginning of 1990 the use of laser treatment for the correction of myopia. When the condition of myopia requires larger corrections to the corneal shape, the principal of LASIK (LASIK = Laser in situ keratomileusis) is employed. As illustrated in Figure 1, this method consists of cutting a thin parallel lamella 1 of corneal tissue from the surface of the cornea 2. To aid in the cutting process a distance holder 3 included in the microkeratome aids in the formation of lamella. The corneal lamella remains attached by a hinged portion 4, as shown in Figure 2, of corneal tissue and thereafter the microkeratome is retracted from the cornea. The flap is then held back and a laser beam 5 is used for treatment of the inside tissue 6 of the cornea. Thereafter as shown in Figure 3 the flap is repositioned on the cornea. The flap is only 13/100 to 18/100 of a mm thick. A suture is not needed as osmotic forces hold the flap in place. The procedure of forming a lamella corneal flap to expose corneal tissue for laser treatment offers the advantage of faster healing, less discomfort for the patient and more stability.

Multiple microkeratomes have been developed over the years, all following the same principal of primarily creating a flat surface on the cornea whereafter the cut is performed similar to a carpenter's plane. A motor is used to move the blade in all microkeratome and in some microkeratome rotates the blade. There is a known microkeratome using one motor for movement of both the blade and the microkeratome.

The movement of the microkeratome to execute the corneal cutting is performed on a suction ring that surrounds the corneal circumference and is adhered firmly to the corneal dome. The position of cornea within the suction ring allows the microkeratome to create a flat corneal surface from the corneal dome. The movement of the microkeratome on the ring is guided within dove tail guides.

It is an object of the present invention to use a motor to form a mechanically interconnecting relationship between a corneal suction ring and a microkeratome in such a way that the operation of the motor effects relative displacement between the ring and the microkeratome for controlling cutting of corneal tissue.

It is a further object of the present invention to secure an electronically geared stepping motor to a microkeratome and use a steering rod to form a releasably locked interconnection between the output of the stepping motor and a corneal suction ring for controlling cutting of corneal tissue.

According to the present invention there is provided an apparatus for transverse planar cutting of a cornea to expose a corneal surface to allow correction of myopia, the apparatus including a corneal suction ring including microkeratome guide surfaces extending along opposite aides of an aperture for exposing a portion of a cornea, a microkeratome guided by the guide track surfaces of the corneal suction ring to execute at least a partial transverse planar cut of a cornea surface in the aperture of the corneal suction ring; and an electronically controllable actuator operatively interconnecting said microkeratome and the comeal suction ring for controlling relative movement between said corneal suction ring and said microkeratome.

According to the preferred embodiment of the present invention there is provided an apparatus for transverse planar cutting of a cornea to expose a corneal surface to allow correction of myopia, the apparatus including, a corneal suction ring including a cornea engaging surface on a side thereof and microkeratome guide tracks on an opposite side, the guide tracks having spaced apart and parallel dove tail guide tracks extending along opposite sides of an aperture for exposing a portion of a cornea, a steering rod releasably secured to an outer wall of the suction ring, a microkeratome including a blade driven by a motor to execute a transverse planar cutting of corneal surface exposed by the comeal suction ring, the microkeratome having a dove tail for engaging and guidance by the dove tail tracks on the corneal suction ring and a stepping motor connected to the steering rod and the microkeratome for controlling relative movement between the corneal suction ring and the microkeratome.

The present invention will be more fully understood when the following description is read in light of the accompanying drawings in which:

Figure 1 is a schematic illustration showing the use of a microkeratome for executing a cut of a hinged lamella portion of a cornea to allow laser treatment for correction of myopia;

Figure 2 is a schematic illustration of the laser correction treatment;

Figure 3 is a schematic illustration showing the cornea after myopia correction;

Figure 4 is a elevation view partly in section illustrating the preferred form of the apparatus for performing the transverse cutting of the cornea according to the present invention; and

Figure 5 is a partial plan view taken along lines V-V of Figure 4.

For the purposes of disclosing the preferred embodiment of the present invention, as shown in Figures 4 and 5 there is illustrated a corneal suction ring 10 having annular side walls and a concave bottom wall 12

having a shape for affixing to the cornea of the eye by suction in a manner per se well known in the art. On the top surface of the corneal suction ring which is opposite the corneal engaging surface there is formed dove tail guide tracks 14 and 16 that are spaced apart and parallel extending along opposite sides of an aperture 18. Affixed to the outer peripheral surface of the suction ring at diametrically opposite sites are receiver sockets 20 and 22. The receiver sockets are centrally spaced between the parallel arrangement of dove tail guide surfaces. Associated with each of the receiver sockets 20 and 22 is a spring clamp 24 which is urged under a resilient force of this spring into a slot traversing the sockets so that a part of the clamp protrudes into a hollow pocket of each receiver socket to engage in a annular recess formed on the end of a steering rod 26. The steering rod is connected to the linearly moveable output member of an electronically geared stepping motor 28 that is operated by a controller 28A so that the linear output speed is controllably selected at a given speed usually within the rage of 0.5 mm/second to 3 mm/second. Fastened to the housing portion of motor 28 is an angled bracket 30 which forms a mounting structure for mechanically connecting the microkeratome 32. The microkeratome is per se well known in the art and includes a motor for operating a cutting blade and on the bottom portion there of a dove tail is formed for mating engagement with the dove tail surfaces 14 and 16. The stepping motor operates to move the microkeratome relative to the cornea suction ring. Forces producing this movement are exerted centrally by the positioning of the steering rod with respect to the parallel arrangement of dove tail guide surface and this arrangement assures movement of the microkeratome without the risk of binding. The movements are relative to each other so that the ring may move towards or away from the motor or if the ring is held, then the stepping motor will move towards and away from the ring, thereby also moving the microkeratome along the dove tail guides. The control for the motor, in addition to speed, controls the total movement of the microkeratome through establishment of the distance that the steering rod is moved relative to the housing and in this manner, the cut of comeal tissue by the microkeratome establishes the width of the hinge attaching the lamella flap to the cornea.

While the present invention has been described in connection wit the preferred embodiments of the various figures, it is to be understood that other similar embodiments may be used or modifications and additions may be made to the described embodiment for performing the same function of the present invention without deviating therefrom. Therefore, the present invention should not be limited to any single embodiment, but rather construed in breadth and scope in accordance with the recitation of the appended claims.

Claims

1. An apparatus for transverse planar cutting of a cornea to expose a corneal surface to allow correction of myopia, said apparatus including:

   a corneal auction ring including microkeratome guide surfaces extending along opposite sides of an aperture for exposing a portion of a cornea;

   a microkeratome guided by the guide surfaces of the corneal suction ring to execute at least a partial transverse planar cut of a cornea surface in the aperture of the cornea suction ring; and

   an electronically controllable actuator operatively interconnecting said microkeratome and said corneal suction ring for controlling relative movement between said corneal suction ring and said microkeratome.

2. The apparatus according to claim 1 further including a steering rod interconnecting said corneal suction ring and said electronically controllable actuator, said actuator displacing the steering rod in the direction in its length for the relative movement between the corneal suction ring and the microkeratome.

3. The apparatus according to claims 1 or 2 wherein said guide surfaces of the corned suction ring comprise dove tail guide surfaces and said microkeratome includes a dove tail guide for mating engagement with the dove tail guide surfaces of the corneal suction ring.

4. The apparatus according to claims 1, 2 or 3 wherein the microkeratome includes a motor for moving a cornea cutting blade to cut a portion of a cornea surrounded by said cornea suction ring.

5. The apparatus according to claims 1, 2, 3, or 4 wherein said steering rod extends radially outward from said corneal suction ring in a generally parallel and central relation to the dove tail tracks.

6. The apparatus according to claims 1, 2, 3, 4 or 5 wherein the suction ring includes a receiver having a cavity for receiving an end portion of said steering rod and a retainer supported by the suction ring to maintain a releasable interconnected relation between the steering rod and the suction ring.

7. The apparatus according to claims 1, 2, 3, 4, 5 or 6 wherein the suction ring includes receivers at diametrically opposite edges of said suction ring with

each receiver being spaced centrally between the dove tail tracks, each receiver including a cavity for selectively receiving an end portion of said steering rod, and a retainer supported by the suction ring for each receiver to maintain a releasable interconnected relation between the steering rod and the suction ring.

8. The apparatus according to claims 1, 2, 3, 4, 5, 6 and 7 wherein said electronically controlled actuator includes an electronically geared stepping motor for linear displacement of said steering rod at a speed that is controllably selected.

9. An apparatus for transverse planar cutting of a cornea to expose a corneal surface to allow correction of myopia, said apparatus including:

a corneal suction ring including a cornea engaging surface on a side thereof and microkeratome dove tail guide surfaces on an opposite side, the dove tail guide surfaces being spaced apart, parallel and extend along opposite sides of an aperture arranged for exposing a portion of a cornea;

a steering rod releasably secured to an outer wall of said suction ring;

a microkeratome including a blade driven by a motor to execute a transverse planar cutting of corneal surface exposed by the corncal suction ring, said microkeratome having a dove tail for engaging and guidance by the dove tail tracks on the corneal suction ring; and

a stepping motor connected to said steering rod and said microkeratome for controlling relative movement between said corneal suction ring and said microkeratome.

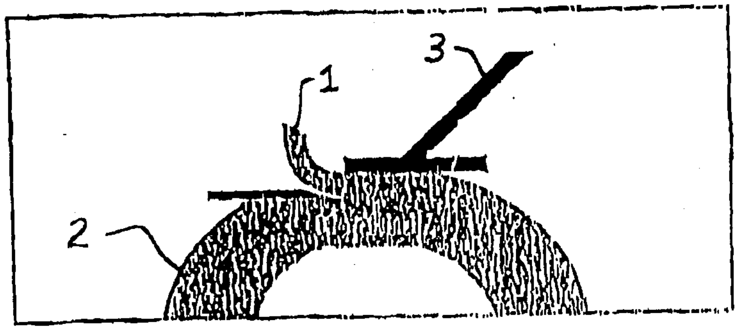

FIG. 1

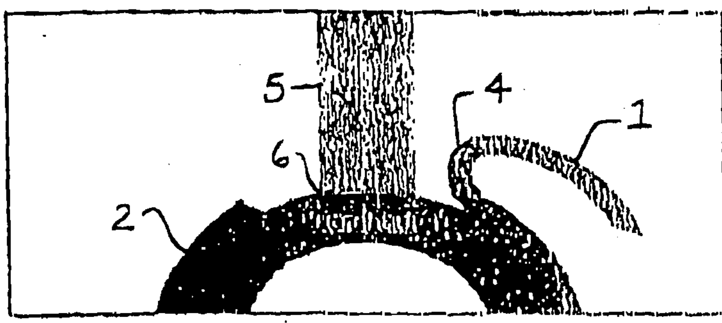

FIG. 2

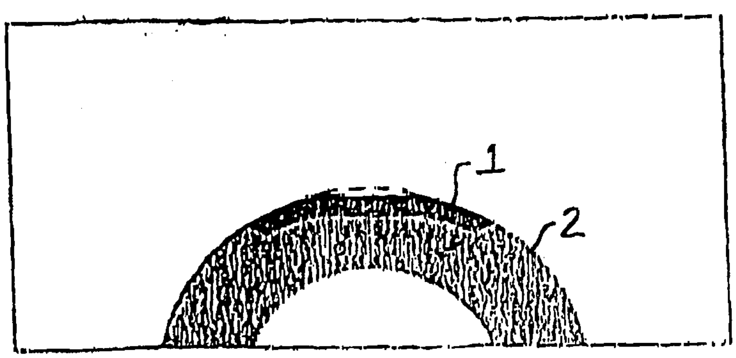

FIG. 3

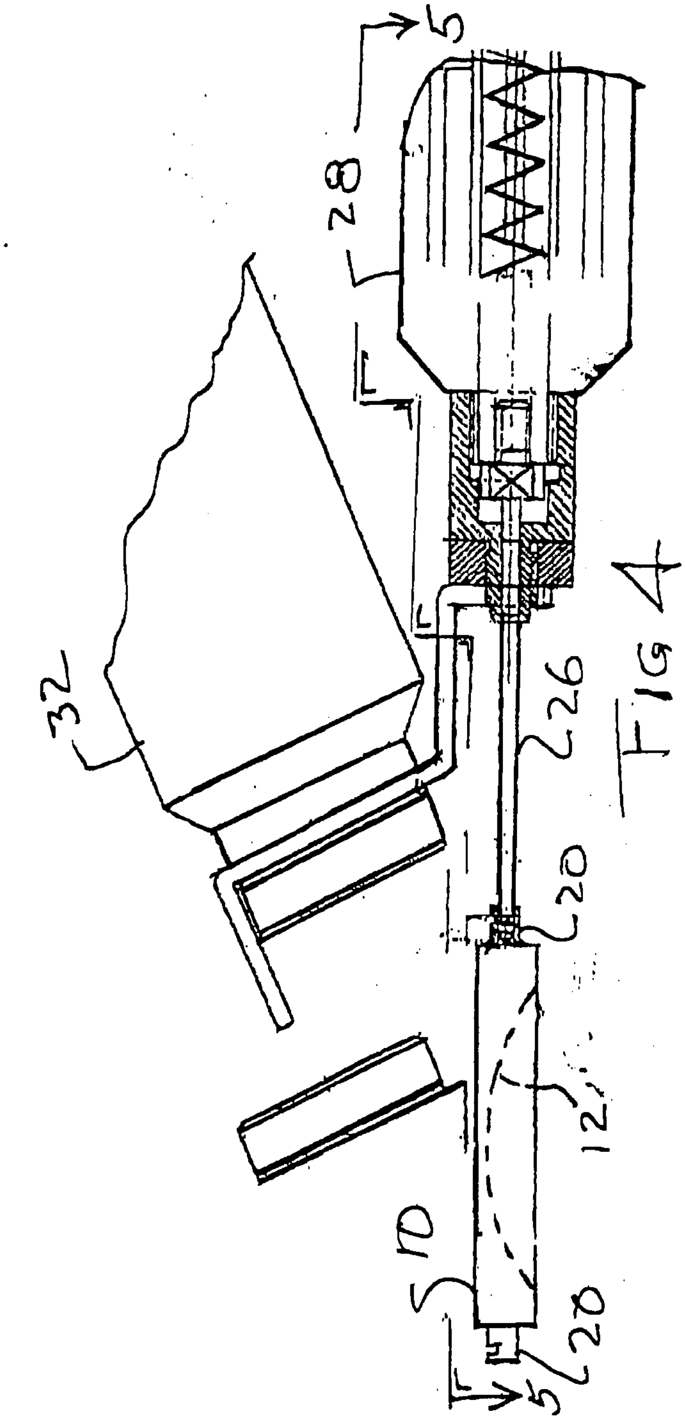

FIG 4

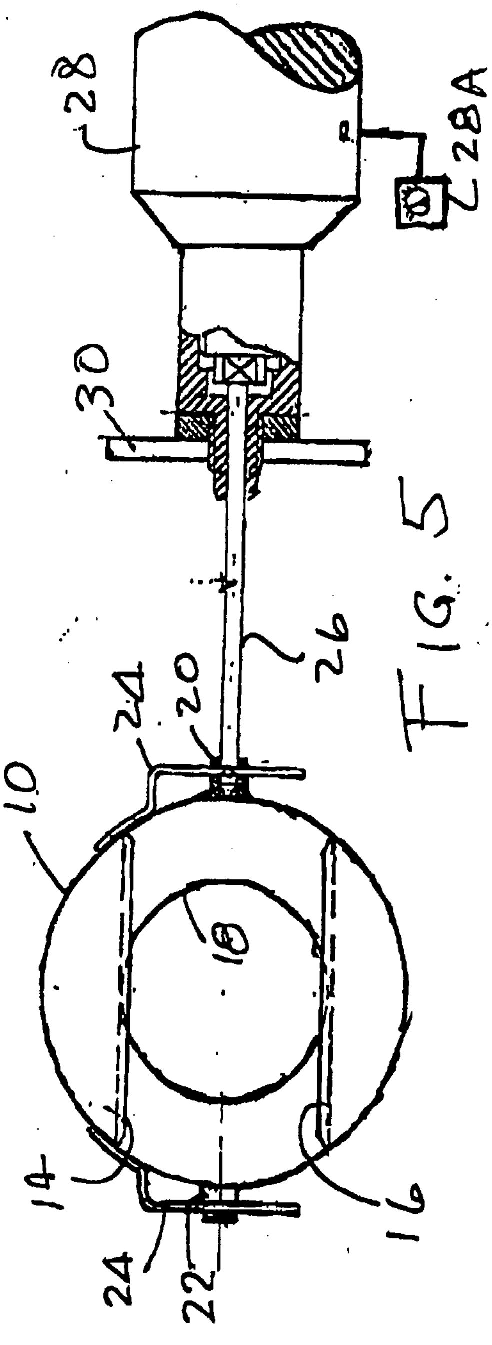

FIG. 5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 10 6949

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP 0 442 156 A (RUIZ LUIS ANTONIO ;LENCHIG G SERGIO (CO)) 21 August 1991	1	A61F9/013
A	* claims; figures 1,10 *	3,4,9	
X	WO 95 31143 A (KOEPNICK RUSSELL G) 23 November 1995	1	
A	* claims 1,10,19; figures 26,28 *	4,9	
E	EP 0 771 553 A (SCHWIND GMBH & CO KG HERBERT) 7 May 1997 * claims 1,11-19; figures 1,2 *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A61F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	19 September 1997	Kanal, P

CATEGORY OF CITED DOCUMENTS

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